Problems in Learning Chemistry for Non- Specialized Students in Faculties of Education, University of Zawia

NAJAH YOUSEF BAROUD

Chemistry Department –Faculty of Education, Zawia - University of Zawia

Zawia - Libya

Email: n.baroud@zu.edu.ly

ABSTRACT

The current study uses a questionnaire to determine the shortcomings of non-specialized chemistry students. The research highlights a number of problems associated with studying of chemistry for non-specialized students in faculties of education in University of Zawia. An online questionnaire was send to non-specialized student in different faculties of Education. A hundred and eight answers were submitted. The Most common difficulties in learning chemistry for non-specialized students include: problem-solving, chemistry background, chemical reactions. The most common recommendations and suggestions to improve the curriculum include: attention to diversity and inclusion in curriculum content, technology facilitates the process of learning chemistry, developing teaching chemistry methods.

Keywords: chemical education, laboratory of chemistry, curriculum، learning chemical reactions.

مشاكل وتحديات تعلم الكيمياءللطلبة غير المتخصصين في كليات التربية– جامعة الزاوية

نجاح يوسف بارود

قسم الكيمياء– كلية التربية الزاوية- جامعة الزاوية

الزاوية – ليبيا

Email: n.baroud@zu.edu.ly

الملخص:

يشكل تعلم الكيمياء تحديًا للطلاب غير المتخصصين في كليات التربية. استخدمت الدراسة الحالية استبيانا لتحديد أوجه القصور لدى طلاب الكيمياء غير المتخصصين. يسلط البحث الضوء على عدد من المشكلات المرتبطة بدراسة الكيمياء للطلبة غير المتخصصين في كليات التربية بجامعة الزاوية. تم إرسال استبيانا إلكترونيا عبر نموذج جوجل إلى الطلبة الغير متخصصين في كليات التربية المختلفة،

وتم تسجيل عدد مائة وثمانية إجابة للاستبيان. تشمل الصعوبات الأكثر شيوعًا في تعلم الكيمياء للطلاب غير المتخصصين ما يلي: حل المسائل الكيميائية، خلفية المتعلمين عن الكيمياء، التفاعلات الكيميائية. وتشمل التوصيات والمقترحات لتحسين تعليم الكيمياء وتتطوير المناهج ما يلي: الاهتمام بالتنوع والشمول في محتوى المنهج، استخدام التكنولوجيا في تعلم الكيمياء، تطوير طرق تدريس الكيمياء.

الكلمات المفتاحية: ، تعليم الكيمياء، تعلم التفاعلات الكيميائية ، تتطوير المناهج، معمل الكيمياء.

Introduction

Chemistry is one of the most significant areas of science; it is a science subject that requires pupils to visualize abstract concepts **(Stavy and Tirosh, 2000).** It is the inquiry into the cause-and-effect relationship between two substances. The study of a substance's composition, structure, characteristics, and transformations is another way to characterize chemistry. Everyone's life is impacted by chemistry, the basic needs for food, clothing, energy, health, and water, all dependent on chemistry. Chemistry as a subject can be quite daunting, a perfectly crafted mix of symbols, nomenclature, and equations which somehow make our physical world. Chemical technologies provide novel solutions to material, energy, and health-related problems, which enhances our quality of life in many ways. It is a challenging subject for many students because most of its themes are based on or linked to the structure of matter. Many abstract ideas, which are essential to understanding chemistry and other disciplines in greater detail, are frequently included in chemistry courses **(Taber, 2002).** Chemical education can serve three purposes. First, it can provide a preparation for those who are to conduct research and/or development in chemistry or to staff the production processes of chemical-based industries. Second, it can provide a component of the general education of the population. Third, it can act, to some degree, as an exemplar for the conduct and outcomes of science **(Gilbert, J. K. 2002).** Many students have a bad attitude about chemistry from an early age, which affects their performance in the subject. Actually, studying chemistry comes with a lot of challenges. The surroundings have an impact on memory, for instance, it is quite difficult to learn well if you are preoccupied, worried, or unable to practice and review due to certain situations **(Siddique, M. 2022).** At the beginning of any course, students start their study with a set of beliefs about the nature of learning and what they intend to achieve. These beliefs are derived from earlier school and experiences as well as their current goals and motives. **(Biggs and Moore, 1993)** Quality education

and teaching is a prerequisite for the successful formation of pupils' knowledge. Therefore, different ways of improving the quality of education and teaching are constantly sought. A number of measures are taken to improve the quality of teaching and the overall development of the educational process in schools: improvement of the curriculum **(Metz, 1997)**. Lecturers can create more successful teaching tactics by having a better grasp of how pupils learn. This necessitates making learning process research publicly available **(Clow, 1998)**. One was that it drew on ideas about the nature of curriculum, teaching, and learning, from the generic subject of educational research. The other was that it drew on the specific subject matter and enquiry approaches of chemistry. Chemical education research was either the application of the ideas of educational research to the subject of chemistry or vice versa. More recently, however, a degree of integration has been achieved between educational research and chemistry to give a more coherent approach **(Farrant, 1981).** This has been possible for two reasons. First, because teaching and learning, with the rise of constructivism, have come to be seen as more content-specific. This has legitimized enquiries into the curriculum, as well as into teaching and learning, in the specific area of chemical education. Second, because the nature of chemistry itself has come to be seen both as problematic and distinctive **(Kempa, 1992)**. When teachers using a constructivist approach to instruction, it is beneficial to have a form of assessment to measure the effectiveness of what students have learned. This can be done with outcome based assessment. It is a form of assessment that measures a change in a specific behavior of a student. This can be done in a student observation when they are exposed to the learning activity, an assessment could be done to investigate the way they do things before and after learning something. This is meant to uncover any misconception a student had in learning a certain topic. This type of assessment is said to be more beneficial than traditional item measures given **(Aydisheh, F.and Gharibi, H. 2015)**. The aim of this study is to identify problems associated with studying chemistry for non-specialized students in faculties of education based on the students online questionnaire, provide recommendations and suggestions to development the chemistry curriculum to overcome chemistry learning difficulties.

AREA OF THE STUDY

This study covers number of non-specialized students in biology and physics departments in University of Zawia (Al-Ajeelat, Nasser, Zawiya, Abu Issa)

STATEMENT OF THE PROBLEM

Chemistry is a subject that overlaps with other disciplines like biology, physics and medical science. It has produced countless discoveries, but it always needs to be studied under certain circumstances. There are many difficulties related learning and teaching chemistry to non-specialized, thus it's important to recognize them and offer potential solutions.

METHOD AND INSTRUMENT OF DATA COLLECTION

The researcher used Google Forms online questionnaire, and the answers sent automatically to the researcher's account. The questionnaire has 26 questions covered problems associated with studying chemistry for non-specialized students in some departments of faculty of education. Most of the items cover Yes or No response. 108 responses were recorded.

RESEARCH QUESTIONS

1-what are the most common difficulties in learning chemistry for non-specialized students?

2-what are the s recommendations and suggestions to qualify the chemical education for non-specialized students?

RESEARCH DESIGN

Descriptive design was using in this investigation. When a group of people or things is the subject of a survey research, data from a small number of subjects or objects that thinking to be representative of the entire group gathering and analyzed **(Emendu, 2015).**

METHOD OF DATA ANALYSIS

To analyze the data and provide answers to the study objectives, a percentage was employed.

Research Question 1: what are the most common difficulties in learning chemistry for non-specialized students?

The research question 1 is answered in table below:

Table 1: most common difficulties in learning chemistry for non-specialized students

No.	Common difficulties in learning chemistry	Yes%	No%
1	Problems in understanding basic concepts in chemistry	63.6	36.4
2	Foreign language of chemical terminology	65.6	34.4
3	Solving problems difficulty	73.6	26.4
4	Chemical reactions understanding difficulty	72.6	27.4
5	Difficult linking chemical concepts to practical applications	69.4	30.6
6	Difficulty working in the laboratory	61.5	38.5
7	Difficulties in understanding chemistry in secondary school	73.1	26.9
8	Mathematics makes the chemical problems more difficult	59.7	40.3
9	Difficult to apply theatrical concepts practically	62.6	37.4
10	Exam questions are complicated for non-specialized students	67.4	32.6

Table 1 shows that the most common difficulties in learning chemistry for non-specialized students include: solving problem 73.6%, chemistry background 73.1%, and chemical reactions.

The research question 2 is answered in table below:

Table 2: recommendations and suggestions to qualify the chemical education for non-specialized students

No.	Recommendations and suggestions to qualify the chemical education	Yes%	No %
1	Differentiate between specialized and non-specialized students in explanation	80.3	19.7
2	There is no support from the department administration	64.2	35.8
3	No opportunity to conduct practical experiments themselves	67.9	31.1
4	Supporting classes in chemistry	72.2	27.8
5	Using animation and charts (Visual learning)	83.2	16.8
6	Encouragement to learn new chemistry topics	75.7	24.3
7	Receive adequate explanations from lecturers to improve the understanding	63.9	36.1
8	The curriculum intended for non-specialists should be simplified	85.2	14.8
9	Attention to diversity and inclusion in chemistry content	88.9	11.1
10	Supporting subjects that contribute to clarifying chemical concepts	83.2	16.8
11	chemistry teaching methods develop to suit the non-specialized students	87	13
12	Technology facilitate the process of learning chemistry	88.1	11.9
13	External sources (educational videos or books) helping for understand	82.4	17.6

Table 2 shows: that the most common recommendations and suggestions to qualify the chemical education for non-specialized students includes:

attention to diversity and inclusion in curriculum content 88.9%, technology facilitates the process of learning chemistry 88.1%, developing teaching chemistry methods 87%.

SUMMARY OF THE WORK:

Most common difficulties in learning chemistry for non-specialized students:

1. ***Chemical Concepts***: College students studied chemistry in high school but in undergraduate level, some concepts are so foreign for them, courses taken non-specialized students contain a large amount of chemical concepts need to Simplifying and summarizing. So what needed is a teaching approach that will promote lasting knowledge of chemical concepts and will provide a foundation for understanding future developments in chemistry.
2. ***Foreign language***: The importance of this trend is brought into sharp focus when we consider the international nature of science. English chemistry concepts are difficult for most non-specialized students who speak Arabic.
3. ***Chemical reaction and problems solving****:* One of the biggest challenges faced by students is the perception that there are too many reactions to learn and that they are unrelated to each other. The ability to solve problems and eventually teach others how to do so will be an inherent outcome provided enough time is invested **(Salame I., et al 2020).** Understanding the importance of mastering chemical reactions is the starting point for using those reactions to learn problem-solving.
4. ***Linking chemical concepts to practical applications*****:** Probably the most common way in which students expect chemistry to be explained in practical terms is through experiments. Due to concerns over safety and resource management, it is often difficult to create a link between experimental work and the concepts being taught. It may be difficult to convince students that their energy, and time has not been wasted learning about something which has no "real-world" application **(Hofstein, A. M Hugerat2021).** There are three main areas in which it is often difficult to link chemical concepts to practical examples: limited resources for practical application examples, complexity of chemical concepts, and lack of real-world context, it can be challenging for students who are not

specialists to make the connection between the theoretical and real-world components of the curriculum.

5. ***Working in the laboratory:*** Since the 19th century, laboratory work has been an important part of the chemistry curriculum. The necessity of handling hazardous chemicals in the laboratory means that personnel are at risk of exposure to potential harm through inhalation, skin contact, or ingestion. It is, therefore, essential that appropriate protective clothing is worn at all times when working in the chemistry laboratory. Some students express dissatisfaction with the complexity of laboratory experiments, their limited talents, and the fact that, lab supervisors deny them the chance to work themselves.
6. ***Mathematics understanding:*** The Quantitative Understanding Learning Progression in Chemistry was developed to map the progression of student understanding of the use of mathematics in chemical problem solving. Some chemical calculation problems require understanding mathematics, and this problem is common among students, especially in analytical chemistry
7. ***The Impact of Inadequate High School History in Chemistry Education:*** Present day school education has a strong focus on making sure that the youth of the world obtain useful and relevant information. It is agreed by students that information that is of no use to them is pointless and so it is cast aside. Students are encouraged very strongly to take this view with their education, students give up certain topics if they aren't in the exam. They feel that time spent on something that is not pertinent to their exam is time wasted. Thus, students have little awareness that science is another form of human endeavor that occurred in a particular context and would not exist today were it not for the work of predecessors. Types of exam questions: Some students who are not majoring in chemistry believe that the level of exam questions is suitable for students majoring in chemistry.

RECOMMENDATIONS AND SUGGESTIONS

1. ***The Influence of Chemistry Education on Non-Specialist Students*:** The evidence is that non-specialized students find chemistry more difficult than other science subjects and have lower self-confidence in their ability to tackle it. However, a major issue for all is how the concepts in chemistry are taught and learned. Specialized students have already

developed an interest in the subject. This interest would drive them to find out things that are beyond the syllabus to enhance their understanding. This clarifies the point that specialized students will definitely have a better understanding of chemical issues compared to a non-specialized student. Chemistry courses are usually designed for specialized students who follow a three-year or four-year special degree program in chemistry as the main subject. So that, chemistry lectures should be keep in their considering the differences between the two types of the students and redesign the curriculum.

2. ***The role of department administration***: The department head must support students by providing some books and references and contributing to the progress of the educational process.
3. ***Opportunity of work in laboratory****:* The experimentation an integral part in teaching chemistry and should continue to provide the average student with the values that skill and patience can bring, Laboratory staff must supervise students while they undertake independent laboratory activities. They will have more opportunities as a result to comprehend the laboratory and not feel afraid of it.
4. ***Supporting class:*** lecturers should give extra classes to help students understand more; it can follow the same content as the regular class or have different content entirely. Depending on the learning area and lesson structure supporting classes is very important for students with lower ability fail to understand the topic taught.
5. ***Visual learning*****:** Chemistry educators are constantly seeking new ways to challenge their students and to stimulate their interest in the ever-challenging material that the science requires. It is important to clearly and accurately present scientific concepts to students in hopes that the students will understand the concepts and be able to apply those concepts in a variety of situations. This is where the power of animations and simulations becomes most valuable. A stimulating and exciting tool is one that has the potential to captivate the audience of the educators it is meant for. This is done by using many bright colors and motions and often humor and fancy. Captivation is the first step that leads to enhanced motivation for learning. An enthusiastic student is more likely to find enjoyment in chemistry and more likely to explore ideas outside of the classroom and/or seek further explanation.

6. ***Learning new chemistry topics*:** It is very important for teachers of chemistry to encourage the belief that learning in the sciences does not end after one has completed a course or a degree. All of this is "general" knowledge and understanding necessary for an informed public and must impress upon the student the fact that the information learned in chemistry does not become outdated after the final exam.
7. ***A good explanation*:** Teacher should know that the Elicitation can be tricky because they might not realize that they are using a concept that students may not be familiar with. In a good explanation, a teacher will elicit the wrong idea from the student before 'diagnosing' it and then presenting the right idea.
8. ***Simplify the topics*:** Learning the language of chemistry requires that the students master a great deal of vocabulary, by simplifying the material, understanding is made easier for everyone. This is the first step in getting all students to be successful in a learning environment. Success is when behavior and performance meet expectations. Anyone who teaches knows that the expectation is that everyone will learn what is being taught. The simplified approach makes meeting this expectation possible for all students.
9. ***Attention to diversity and inclusion in chemistry*:** A diverse and inclusive environment is essential for the promotion of learning, comprising both personal and professional development. Chemistry is a central science, which means that it is studied by several students who are non-chemists. This means that a chemist may identify the necessity for a diverse environment. Chemistry in itself is a diverse subject, but in the context of education, diversity can be interpreted in many different ways including culture, learning style, age and gender.
10. ***Improving Mathematical recognizing*:** A significant emphasis is on recognizing that mathematical processes have no inherent meaning and only acquire meaning when applied to a chemical context. This can be assisted by techniques that attempt to improve students' capacity to generate and manipulate qualitative statements, solve problems and persevere, and employ correct notation. Step-by-step guidance sequences for mathematics issues can help students locate and integrate key mathematical and chemical concepts.
11. ***The curriculum*:** The purpose of the chemistry subject for non-specialists is to understand the fundamentals of chemistry in a detailed and engaging

manner. The material within breaks down complex ideas using simple language and provides ample opportunity for students to practice different concepts. Each lesson reinforces the material that was learned in the previous lessons, thereby eliminating the problem of teaching to the test which typically occurs in classrooms. The curriculum is meant to educate the individual and leave them with a lasting understanding of chemistry, as opposed to memorization. Additionally, the material can be utilized by teachers in their own classrooms to supplement the teacher's current lesson plans. Activities and worksheets are available for most lessons and can be used as they are, or modified to fit the style of teaching in a particular classroom. By allowing teachers to utilize this material, more students will have the opportunity to learn chemistry at a greater depth than that which is currently achieved. Lecturers need to pay closer attention and put in more effort to get better outcomes of Chemical reaction and problems solving because this is one of the most significant exam problems that most non-specialist students are unable to answer.

12. ***Developing teaching methods***: There is a growing trend among these students to put less importance on their chemistry education. Many are under the impression that unless they are chemistry or biochemistry majors, they will not be using chemistry after they graduate and therefore do not need to focus too much on learning and understanding the material.
13. ***Importance of Technology in chemical education:*** The modern technologies developed may even influence changes to our current understanding of how teachers teach and how students learn. The visualization tools available in technology can be employed in transmitting abstract concepts and events concrete, though technology has been a part of education for many years now; there is a distinct lack of technology-driven tools for education in chemical sciences. The need for novel approaches to forge a solid connection between the theoretical and experimental facets of chemical research and education is pressing. In order to successfully connect the various facets of chemical research and education, these tactics necessitate the integration of cutting-edge experimental and measurement techniques, intricate computational and informatics methodologies and theories, and creative teaching and evaluation approaches. This is only possible if the students' technological resources match the requirements of the course.

14. ***Extra information***: An external source can be a print or online periodical, pamphlet, or a report from a meeting, conference, or from a study involving analysis, leading to synthesis of new information. The primary reason for accessing these external sources is to obtain information which is not present within a personal knowledge base. The information taken from these sources is relevant to knowledge-based decision making and problem solving, promoting the possibility for individual discovery. It is critical today to find and evaluate information found in external sources.

CONCLUSION

Learning chemistry is extremely hard, requiring knowledge of numerous abstract ideas. Students frequently believe that the material is tough to retain and that the numerous intricate chemical laws are difficult to comprehend. The traditional method of teaching and learning chemistry does not cater to those who have a lower ability to understand. The teacher will only teach a certain topic in chemistry for a few periods only, and a lot of students with lower ability fail to understand the topic taught. Sooner or later, the gap between those with lower ability and those with higher ability will become larger **(Schank, P and Kozma, .R 2002).** In the end, those with lower ability will consider chemistry as a tough subject and not suitable for them. This will kill the student's interest in studying chemistry. This is where supporting classes in chemistry can be an alternative for these students. In order to encourage students to study science, it is very important that science is taught, not just as a body of facts, but as a process to understand the world around us. To do this, students must be shown that what they learn in their books has a use in the real world. This is often most challenging in chemistry due to factors linked both to the abstract nature of much of chemistry and to the fact that students often do not appreciate the relevance of chemistry to their lives. Despite these challenges, it is essential that chemistry teachers link chemical concepts to practical examples **(Cardellini L, 2012)**. For many students, the failure to see this link is a reason to drop the subject. It is our opinion that the failure of pupils to see this link reflects not just on the pupils, but also on the teacher and the taught curriculum.

REFERENCES

Biggs, J.B. and Moore, P.J., (1993). The Process of Learning. Sydney: Prentic Hall. Bodner, G. M (1986) Constructivism: A Theory of Knowledge, Journal of Chemical Education, 63(10), 873-878.

Emendu. (2015). Identifying Problems Associated with Studying of Chemistry in Anambra State, Nigeria. *International Journal of Scientific and Research Publications, , June 2015 ISSN , Volume 5*(Issue 6,).

Farrant J.S. (1981). Principles and Practice of Education. Great Britain: Morrison and Gabbs

Gilbert, (2002). *Chemical Education: Towards research-based practice*. Kluwer Academic Publishers.

Kempa, R. F. (1992). Research in chemical education: past, present and future. In R. Maskill (Ed.), Research in assessment (pp. 6-31). London: Royal Society of Chemistry

Metz, K. (1997). On the complex relation between cognitive development research and children's science curricula. Review of Educational Research, 67(1), 151–163. Retrieved from https://doi. org/10.3102/00346543067001151

Siddique, M. (2022). Attitude Towards Learning Chemistry: A Case Of Secondary School Students In Pakistan. *Journal of Positive School Psychology , Vol. 6*.

Stavy, R.,and Tirosh, D. (2000.). *How students (mis-)understand science and mathematics intuitive rules*. Teachers College Press.

Taber, K. S., (2002). Alternative Conceptions in Chemistry: Prevention, Diagnosis and

Cure? London: *The Royal Society of Chemistry*.

Aydisheh, F.and Gharibi, H. (2015). Effectiveness of Constructivist Teaching Method on Students' Mathematic Academic Achievement. *Mediterranean Journal of Social Sciences , 6*(6 s2), 572–578.

Cardellini L,. (2012). Chemistry: Why the subject is difficult? *Educación Química*, *23*, 305–310. https://doi.org/10.1016/s0187-893x(17)30158-1

Schank,. P Kozma, .R (2002). Learning Chemistry Through the Use of a Representation-Based Knowledge Building Environment. *Journal of Computers in Mathematics and Science Teaching*, *21*.

Salame I., et al (2020). *Examining Challenges That Students Face in Learning Organic Chemistry Synthesis*.

Hofstein, A. M Hugerat. (2021). *Teaching and Learning in the School Chemistry Laboratory*. https://doi.org/10.1039/9781839164712. 2021 ebook collection